

"SLIDING DOORS WITH CAM GUIDES FOR COPLANAR CLOSING,
PARTICULARLY FOR PIECES OF FURNITURE OR SIMILARS"

The present invention relates to a new embodiment of sliding doors for pieces of furniture or similar decorative elements, particularly of the kind with two shutters and reduced height, having a coplanar closing and the opening made possible by making the doors slide over each other.

Main feature of this invention is that of providing the support and the translation or movement of each sliding door by means of a respective clamp placed on the edge of the outer side, each clamp being linked to a pair of little carriages that can slide transversally with respect to the same door because they are supported and guided by a respective carriage, that, on its turn, can slide longitudinally along the edge of the opening to close, it being guided by a rail and by other control tracks and being forced by its loose roller that is engaged in one of the two rails or longitudinal cams, which are supported and beside the supporting and sliding rail, to bring one of the two doors to slide over the other during the process

of opening and to bring the same door in line with the one at rest during the process of closing.

As an alternative to the usual doors with pivots, some embodiments of sliding doors that can be applied to wardrobes and pieces of furniture in general and to fittings or any other application of closing elements requiring a reduced space in their open position are well-known.

Generally this kind of doors comprise two or more doors, each of them having clamps with rolling means guided by a track made of an upper guide and a lower guide respectively applied to the floor and to the ceiling of the opening to close, a track of one door being beside and parallel to the track of the other door.

The sliding of the shutters in this kind of doors occurs then on parallel planes placed one beside the other, achieving the closing of the opening by alignment or partial overlapping of the edges of one shutter on the edges of the other shutter and with the opposite edges of both the shutters against the edges or the shoulders of the opening to close.

The unaesthetic feature of the sliding doors which are placed during the closing on two different planes, even if they are parallel and not spaced too much apart from each other, in particular with regard to pieces of furniture where aesthetic is very important, has induced the experts in the field to search for new solutions that provide the coplanarity of the two shutters during the closing still assuring their overlapping during the opening.

According to this known technique, the coplanarity of the shutters during the closing is achieved, even if achieved by means of different and more or less complex means, by providing for each shutter a phase of dragging along the respective parallel tracks and a phase of thrust or pressure for its translation in the bottom contiguous track, the opposite end of which already supports and guides the other shutter, to which the moving shutter has to come into line.

The Italian patent No. 1.208.152 accomplishes in fact the task of the coplanarity due to a dragging device that overcomes also the thrust phase, since only by means of the traction the shutter is brought to change the track and till now it seems to be the most easy and effective solution among the proposed ones, particularly in solutions for sliding doors for pieces of furniture, since it is characterized by the fact that for each shutter a pair of guiding rails is provided by means of proper clamps and respective sliding elements, each of said pair of sliding rails including a straight front guide and a second back guide with bended extremity, while the first guide is provided with a part that parts or splits orthogonally and that is turned towards said second guide to allow the translation of corresponding sliding elements of the relative shutter by simple translation of the shutter to be moved.

Anyway, also the relative structural simplicity of the solution for sliding doors proposed by the mentioned patent has revealed a certain complexity during the production and the assembling as well as a certain bulky structure for the support and the translation of the doors.

Particularly, it has been found out that the overall dimensions of the clampings and of the lower rails causes lack of use of the piece of furniture where these sliding doors are applied. It is an object of this invention to provide sliding doors, particularly for high quality pieces of furniture, that achieve the task of coplanarity of their shutters during the closing or closed state besides the obvious overlapping of both sides of the piece of furniture during the opening of the same piece of furniture by simply dragging any of its shutter without adding any phase of thrust, since the translated shutter goes automatically by itself to the same plane of the still shutter at rest during the closing, achieving this movement without changing supporting track or translation guide.

Another object of this invention is to provide sliding doors having a simple structure, an easy assembling and functioning of the translation system still assuring the best overlapping during the opening and coplanarity during the closing of the shutters.

Further object of this invention is that of providing sliding doors that have a translation or movement, overlapping and coplanarity system with reduced overall dimensions or anyway such that it weighs upon the usable volume of the piece of furniture to use only in the least and in the least bulky way.

Last but not least object of this invention is that of being advantageous, in case of shutters being not very high, for the application to sliding doors having a proportional greater length or width of the opening.

These and other objects are perfectly achieved by the present invention as it can be inferred by the following description of one of its embodiment being purely indicative and not limiting, illustrated also with the help of 23 schematic drawings represented in the attached eight sheets in which:

Fig. 1 shows a front vertical view of a casual shape of a piece of furniture, to which a pair of sliding doors are to be applied, said sliding doors closing and opening its suspended space, it being illustrated with the only application of the tracks for the longitudinal sliding of the shutters and the application of the longitudinal support that hold the upper guide of said track;

Fig. 2 shows a transparent top view of the same piece of furniture of Fig. 1 highlighting the position and the shape of the double cam upper guide and of its support;

Fig. 3 shows a transparent lateral view of the same piece of furniture of Fig. 1 highlighting the position of the two guides of the track and of the support that holds the upper guide;

Fig. 4 shows a front view only of the double cam upper guide applied to the piece of furniture of Fig.1;

Fig. 5 shows a top view of the double cam upper guide of Fig. 4;

Fig. 6 shows a cross and enlarged view according to the plan VI-VI of the double cam guide of Fig. 5;

Fig. 7 shows a front view of the profile of lower linear guide embedded on the bottom or floor of the opening to close of the piece of furniture of Fig. 1;

Fig. 8 shows a cross and enlarged view according to the plan VIII-VIII of the profile of lower guide of Fig. 7;

Fig. 9 shows a cross sectional view of one of the two sliding shutters including its clamp for the linking to the translation and coplanarity device as in Figs. 4 to 6 and an elbow bar for the transmission of the guide to the lower slide of Figs. 7 and 8;

Fig. 10 shows a front and overturned view of the longitudinal carriage that is applied indicatively on the centre line of the upper side of the shutter to support and translate, according to what above specified, it being intended to slide longitudinally in proper seats of the support of the guides of Fig. 1 and it being provided with a little carriage that can translate axially with respect to said carriage, thus translating transversally with respect to the same guides of Fig. 1;

Fig. 11 shows a top view of the same carriage of Fig. 10;

Fig. 12 shows a side view of the same carriage of Fig. 10;

Fig. 13 shows a front view of the longitudinal carriage applied to the upper top of the side of the shutter to support and translate according what specified above, it being intended to slide longitudinally into proper seats of the supports of the guides of Fig. 1 and it being provided with a carriage that

can translate axially with respect to said carriage, thus translating transversally with respect to the same guides of Fig. 1;

Fig. 14 shows a top view of the same carriage of Fig. 13;

Fig. 15 shows a side view of the same carriage of Fig. 13;

Fig. 16 shows a front transparent view of a part of the piece of furniture of Fig. 1 including the guides, clamps and other accessories required for the opening translation and the coplanar closing of the right shutter of the same piece of furniture;

Fig. 17 shows a top and transparent view of the same part of piece of furniture of Fig. 16, the right shutter being illustrated in its ordinary closed position on the space of the piece of furniture of Fig. 1;

Fig. 18 shows a side view of the same part of piece of furniture of Figs. 16 and 17;

Fig. 19 shows a top view similar to that of Fig. 17 but including all the accessories required for the opening and the closing of the right shutter of the piece of furniture of Fig. 1, said right shutter being represented in any of the positions of opening or closing of the space of the piece of furniture of Fig. 1;

Fig. 20 shows a top view similar to the view of Fig. 19, the right shutter of the piece of furniture of Fig. 1 being

represented already in phase or state of overlapping on the left shutter for the final part of the opening of the same piece of furniture;

Fig. 21 shows a front view of the same piece of furniture of Fig. 1 completed with the accessories for the movement of its sliding doors according to the invention;

Fig. 22 shows a top view of the same piece of furniture of Fig. 21, it being represented with the sliding doors already closed and coplanary;

Fig. 23 shows a top view of the same piece of furniture of Figs. 21 and 22.

In all the drawings same details are indicated by the same reference numbers.

According to the embodiment illustrated in the different drawings of the attached drawings, a piece of furniture M of any shape has an opening or space V with the bottom F and ceiling S and is closed with a pair of sliding doors 1a and 1b being particularly characterized by their height relative to their greater width.

For a better understanding, the description will refer to the movement of the right shutter 1b, wherein it is clear that the opposite left shutter 1a is provided in an identical and perfectly symmetrical movement system, acting on common guides and supports.

Each shutter 1a and 1b is linked to the short side 2' of an angular clamp 2 (cf. Fig. 9), which is fixed on its opposite and long side 2" to a pair of carriages 3a and 3b applied to the respective longitudinal carriages 4a and 4b as specified below.

Said clamp 2 is located on the upper edge of each shutter 1a and 1b near its corner, the outer side of the same shutter 1 being fixed therein by means of screws 1c or any other known device for a steady linkage, and it has such a length to steadily join or link the two transversal carriages 3a and 3b of each shutter 1.

As already mentioned, the carriages 3a and 3b, respectively, are linked to the long horizontal side 2" of the clamp 2 (cf. Fig. 9) of each shutter 1, said carriages 3a and 3b allowing a relative translation of such clamp 2 in the direction of the depth of the piece of furniture M, moving also the respective shutter 1, to which said clamp 2 is linked.

The movement in depth of the carriage 3a applied to the extremity of the shutter 1b by means of the clamp 2 is possible since said carriage 3a can slide by means of little rollers 31 along proper tracks 41 of a longitudinal carriage 4a as it can be inferred from Figs. 13, 14 and 15.

Said longitudinal carriage 4a is substantially made from a section bar with the mentioned lateral tracks 41 and with an extremity provided with a pivot 42 with loose pulley 43 and the opposite extremity provided with a pivot 44 with bearing or loose wheel 45.

The carriage 3a engages its rollers 31 for the sliding along the carriage 4a also by means of a plate 32 that contains its hubs, besides having a suspended and projecting side 33, to which a pivot 34 of a loose roller 35 is linked.

The carriage 4a is completed by the presence of a loose roller 46 coaxial to the pulley 43 and supported by a proper clamp 47 applied to the extremity of the same carriage 4a.

The positions and the functions of the pulley 43 and of the loose rollers 35, 45 and 46 will be illustrated in detail below, after the description of the different components of the device at issue.

The movement in depth of the carriage 3b (cf. Figs. 10-12) applied on the centre line of the shutter 1b and linked to the already mentioned clamp 2 is possible since the carriage can slide by means of little rollers 31 along proper tracks 41 of a longitudinal carriage 4b as it can be inferred from Figs. 10, 11 and 12.

Said longitudinal carriage 4b is very similar to the contiguous carriage 4a, it being made from a section bar with similar tracks 41 having an extremity 42 provided with loose pulley 43 and the opposite extremity provided with a pivot 44 with bearing or loose roller 45.

Like the carriage 3a also the carriage 3b engages its little rollers 31 for the sliding along the tracks 41 of the carriage 4b also by means of a plate 32 that contains its hubs,

besides having a suspended and projecting side 33, on which the pivot 34 of a loose roller 35 is linked.

A shaped plate 36 is fixed on the inner side of the carriage 4b, so that the end of an elastic mean, for example a traction helical spring 37 can be fixed thereto having its opposite end engaged in a pivot 38 supported and fixed to the projecting end 33 of the control plate 32.

The presence of the elastic means 37 assures the running back of the carriage 3b, when the latter is forced to move along the tracks 41 of the carriage 4b.

The carriage 4b is different from the carriage 4a because no loose roller 46 nor supporting clamp 47 is therein provided.

The longitudinal carriages 4a and 4b of the right shutter 1b of the piece of furniture M at issue are identical to the corresponding carriages of the other shutter 1a, because they are supported and can move in the direction of the length of the piece of furniture M by means of a shape or profile 5 placed along the whole length of the piece of furniture M and supported by proper bosses or clamps 51 fixed to, for example, the sides of the same piece of furniture M.

With particular reference to Fig. 9, it can be inferred that the shape 5, besides having a ribbed structure to assure its greatest resistance, has also a particular front rail 59 for the sliding of the pulley 43 both of the outer carriage 4a and of the inner carriage 4b.

The shape 5 has a control track 58 opposite to said rail 59 and is intended for the sliding of the loose wheel 46 of the carriage 4a , so that also under irregular stress on the shutter 1b, said track 58 assures the perfect longitudinal running of the carriage 4a.

The mentioned shape 5 then has got a sliding track 53 and a shoulder 54 that supports and makes the loose roller 45 slide, which assures together with the guide pulley 43 the support and the longitudinal movement of the carriage 4a as well as of the carriage 4b for the shifting of the shutters 1 along the whole length of the piece of furniture M.

The same shape 5 then has got a proper opening 55 able to house and fix the double cam or upper guide 6 that regulates the overlapping of the two shutters during the opening and assures the coplanarity during the closing, as below better specified.

With particular reference to Figs. 4, 5 and 6, it can be inferred that the upper guide or double cam 6 is substantially formed by a rigid body having fundamentally the same length as the opening V to close and so of the shape 5 that houses and supports it also by means of the lateral supports 51.

Said body 6 shows a groove 61 substantially linear and with ends 61a and 61b bended symmetrically and in a specular way with a pretty sharp radius, in the direction opposite to the side of the sliding shutters or doors 1, its length being, by way of example, lightly longer than $2/4$ of the total length of the guide 6.

A second groove 62, indicated with corresponding section but with almost the same total length as the entire guide 6, is accomplished near the outer edge with extremities 62a and 62b bended symmetrically and in a specular way with a very wide radius in the direction opposite to the side of the sliding shutters or doors 1.

The dimensions of the grooves 61 and 62 of the shape of the guide 6 are able to contain and guide the loose rollers 35 applied to the covering plate 33 of the transversally movable carriages 3a and 3b of the longitudinally movable carriages 4a and 4b.

On the base of what is till now described and with reference to the shutter 1b till now taken in exam, it can be inferred that this shutter 1b is fundamentally supported and moved by the clamp 2 that links and connects the pair of transversal carriages 3a and 3b as well as their respective longitudinal carriages 4a and 4b.

Nevertheless, in order to avoid that this shutter 1b can swing and unhinge the guides and the supports till now considered, also the presence of a lower guide 70 is provided, which, like represented in Figs. 7 and 8, has got a section shape of guide 70 with opening 71, which is preferentially embedded on the bottom or floor F of the opening V to be closed, and which is intended as being linear along the whole length of this opening V.

Inside said lower guide section shape 7 is housed the end 72 of an elbow transmission shaft 73 (cf. Fig. 9), the opposite

end 74 of which is provided with a loose roller 75 housed in an opening 57 of the supporting shape 5 for the double cam or guide 6 as well as for the carriages 3a and 3b and carriages 4a and 4b. In this way, the movement of the shutter 1b remains perfectly balanced.

As illustrated below, the movement of the sliding doors implies that their translation is not only linear but also inclined and relatively hinges on the pivot 35 of the groove 62b, for which the presence of the elbow transmission shaft 73, which, being linked to the shutter 1 by means of the supports 76, distributes the rotation and hinging stress to the whole shutter, avoiding dangerous and fatiguing distortions between the upper control part and the lower dragged part of the shutter 1.

On the base of what is till now described and with particular reference to the Figs. 17, 19 and 20, the functioning of the components which are till now described and the achievement of the above mentioned objects are summarized below with the consideration that, as already specified, both the shutters 1 are perfectly symmetrical and perfectly symmetrical worked.

Starting from the coplanar and closed position of the shutters 1 (cf. Fig. 17), the displacement and opening of the shutter 1b to reach the corresponding part of the opening V is supposed.

In the starting situation of Fig. 17, the shutter 1b is engaged in the closed position, because the carriages 3a and 3b are forced to be in their rest position towards the respective

sliding wheel 45 because of the fact that their guide rollers 35 are engaged in the most rear point 61a and 61b of the respective grooves or cams 61 and 62 of the guide 6.

Dragging the shutter 1b to the left to cause the opening of the space V, also the contemporary movement of the clamp 2 towards the centre of the piece of furniture M with consequent longitudinal translation of the pair of carriages 4a and 4b as well as of the respective carriages 3a and 3b is caused, as illustrated in Fig. 19.

Said longitudinal translation of the carriages 4a and 4b determines then also a differentiated transversal translation of the respective carriages 3a and 3b, which is minimal for the carriage 3a and larger for the carriage 3b, because of the different widths of the camber of ends 61b and 62b of the cams or grooves of guide 61 and 62, in which the respective rollers 35 of the same carriages 3a and 3b are placed.

A different transversal running of the carriages 3a and 3b on the respective carriages 4a and 4b forces the clamp 2 to tilt with partial hinging action on the roller 35 of the cam 62b, and the shutter 1b linked to it to bend, causing so a wide opening of this shutter 1b with respect to the sliding rail 59, such as to allow this shutter 1b to surmount and overlap the shutter 1a, which remains still in its closed position.

The inclination of the clamp 2 caused by the mentioned difference of positions of the carriages 3a and 3b along the bended sections 61b and 62b of the guides 61 and 62 is made possible by the fact that the pulley 43 shows a sliding groove

on the rail 59, which is very countersunk and so does not bring to any slipping off the pulley, even when it is forced to rotate on the same rail 51 in a position lightly tilted on the axis of the longitudinal guide.

Continuing with the opening traction of the shutter 1b, the latter goes beyond the bended sections of the cams 61 and 62 to move with the carriages 4a and 4b and so with the rollers 35 of the respective carriages 3a and 3b to the straight and parallel sections of the same cams 61 and 62, as represented in Fig. 20.

Going beyond the bended sections 61b and 62b of the grooves 61 and 62 causes the restoration of the usual rest conditions of the carriages 3a and 3b, which is also supported by the running back action of the elastic means 37 present on the carriage 3b, therefore, the guide rollers 35 being engaged along the straight and parallel sections of the same grooves 61 and 62, also the shutter 1b comes back to its position straight and parallel to the position of the shutter 1a, overlapping by the same distance existing between the two grooves 61 and 62.

The complete overlapping of the shutter 1b with the shutter 1a is thus made possible without having to induce any thrust or change of rail, leaving the access to the right part of the space V completely free, according to one of the specified objects of the invention.

As already specified, the same functioning and the same result is possible, in case of opening of the shutter 1a, leaving the shutter 1b at rest, provided that there is inversion of

the traction, the components till now described being identical and perfectly symmetrical.

In case of closing the open shutter 1b, to bring it to a closed position coplanar to the already closed shutter, it is sufficient to reverse the direction of the haulage to cause a translation of the respective clamps 2 with the corresponding carriages 3a and 3b, the rollers 35 of which are forced to slide into the bended portions 61b and 62b of the grooves 61 and 62 to cause the inclination of the moving shutter 1b, until it has completely come back to the same plane as the other shutter 1a, i.e. to the position of complete closing, according to another of the above mentioned objects.

Seen the inclination of the clamp 2 along the track, in which the guide rollers 35 of the carriages 3a and 3b go along the bended portion of the grooves 61 and 62, it is clear that the same shutter 1 has to be provided with a shaft 73 for the transmission of the movement, said shaft 73 being elbow shaped, since such a shape allows to distribute the stress of light torsion also to the lower part of the same shutter, which is led by the end 72 in the groove 71 of the lower profile 70, thus assuring the steadiness of the sliding door, besides reducing at least the haulage stress, according to one of the specified objects.

The embodiment till now illustrated is without any devices for the changing of rail or any thrust system to combine with or alternate to the hauling, it being furthermore very simple and safe during the laying and the working or during the ordinary maintenance, according to other specified objects.

Of course, the embodiment till now described can be also differently accomplished, as already mentioned. The possibility of changing or adjusting the length of the guides 61 and 62 of the guide cam 6 with respect to the foreseeable running of the shutters 1 to open or close on the piece of furniture M is given by way of example only.

It is also possible to reverse the direction of the control side till now described, by placing it on the basis or bottom F of the piece of furniture M to be closed, in particular by placing its components in a little space below the opening to be closed, as, for example, already accomplished by the solution of the mentioned patent, but having the advantage of a great reduction of the overall dimensions and a simplification of the components.

According the latter solution, the same carriages 4a and 4b and the same carriages 3a and 3b of each shutter 1a and 1b have to slide along a supporting shape 5, which is differently shaped to support directly the weight of the sliding doors 1 as well as to house the guide cam 6, as well as an adjustment of the angular shape will have to be provided also for the clamp 2, which links the carriages 3a and 3b to the shutter 1a or 1b to translate.

It is also possible to replace the lower straight guide 70 with a guide that has the same double cam shape of the upper guide 6, allowing thus the elimination of the elbow shape of the transmission shaft 73, as well as it is possible to apply a double cam on the ceiling S in case of application of the control system on the base of the shutter 1, thus eliminating

also shaft 73 of distribution and of the shutter during the inclination.

It is then possible to replace the only clamp 2 with a clamp that links each carriage 3a and 3b to the shutter to support, as well as the guide 6 can be supported by the piece of furniture M in a independent way with respect to the shape 5 that includes the rail 59 and the other specified guides.

These and other changings or adjustments of the movement of longitudinal carriages 4a and 4b matched with the movement of the carriages 3a and 3b led by particular cams 61 and 62 are anyway belonging to the originality of the invention to protect.